Science of the Total Environment 627 (2018) 46–56

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Carbon budget and greenhouse gas balance during the initial years after rice paddy conversion to vegetable cultivation

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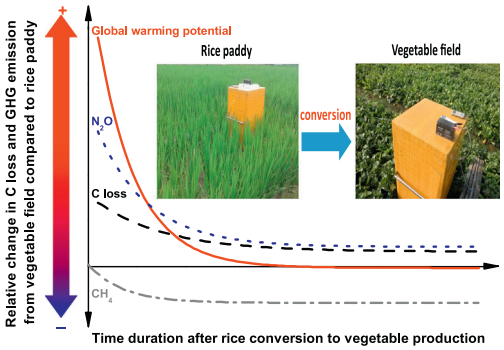
HIGHLIGHTS

- N fertilized rice paddy soil sequestrated 1.14 Mg C ha^{-1} yr^{-1}.
- Conversion of rice paddy to vegetable cultivation led to substantial soil C losses.
- Low C input and fast decomposition explained C loss after land-use conversion (LUC).
- The GWP (C loss, CH_4 and N_2O) strongly increased in the first year after LUC.
- It is especially critical to consider C and GHG balance in the first year after LUC.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 24 November 2017
Received in revised form 20 January 2018
Accepted 20 January 2018
Available online 28 January 2018

Editor: Jay Gan

Keywords:
Land-use conversion
Net ecosystem carbon budget
CH_4
N_2O
Greenhouse gas balance

ABSTRACT

Rice paddy conversion to vegetable production is a common agricultural practice driven by economic benefits and shifting diets. However, little is known on the initial effects of this land-use conversion on net ecosystem carbon budget (NECB) and greenhouse gas (GHG) balance. Annual NECB and emissions of CH_4 and N_2O were measured from a native double rice cropping system (Rice) and a vegetable field recently converted from rice paddy (Veg) under no nitrogen (N) fertilization (Rice-N^0 and Veg-N^0) and conventional N fertilization (Rice-N^+ and Veg-N^+) during the initial four years upon conversion in subtropical China. Land-use conversion from rice to vegetable cultivation led to substantial C losses (2.6 to 4.5 Mg C ha^{-1} yr^{-1}), resulting from strongly reduced C input by 44–52% and increased soil organic matter mineralization by 46–59% relative to Rice. The magnitude of C losses from Veg was highest in the first year upon conversion, and showed a decreasing trend over time. N fertilization shifted rice paddy from a slight C source in Rice-N^0 (−1.0 Mg C ha^{-1} yr^{-1}) to a significant C sink in Rice-N^+ (1.1 Mg C ha^{-1} yr^{-1}) and alleviated the impact of land-use conversion on C loss via increased C input from higher crop productivity. Land-use conversion greatly increased the global warming potential (GWP) from Veg by 116–395% relative to Rice in the first year, primarily due to increased C losses and N_2O emission outweighing the decreased CH_4 emission. However, the GWP did not show obvious difference between Rice and Veg in the

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https://doi.org/10.1016/j.scitotenv.2018.01.207